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This paper describes the development of a database-driven, web-based application that stores motion picture film preservation metadata. The application is derived from the paper film inspection forms that are used in many moving image archives to track the condition and changes in condition over time of film material. Many types of film are volatile and subject to fairly rapid chemical deterioration under the right environmental conditions. Handling of films may also cause wear or damage. The ability to better store and access film preservation metadata will help archivists to better gauge the success of their film preservation practices.

Headings:

Film archives.

Films.

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Motion picture film – Preservation.

Motion pictures -- Archival resources.

Motion pictures -- Archives.

A FILM PRESERVATION METADATA TOOL FOR MOVING IMAGE ARCHIVES

by
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I. Background and Research Problem

Introduction

Motion picture film presents unique challenges to the archive in which it resides, including maintenance of the equipment necessary to provide access; rights management; and deterioration of unstable media. The large number of physical and digital formats can make it difficult to grapple with the intertwined issues of interoperability, access, preservation and cataloging. As film is a medium that can be both physically fragile and chemically unstable, special attention must be given to its physical condition when assessing preservation and storage needs. While the condition of a book or a paper document can be assessed fairly quickly, the inspection of a reel of film is a more involved process, requiring a clean workspace, specialized equipment and specialized knowledge. The film itself is a reference item; it is rarely used for its intended purpose of projection, instead serving as a master from which copies are made.

The focus of this project is film preservation metadata; more specifically, the application of preservation metadata to the field of film preservation. Its purpose is to facilitate greater access to data *about* the condition and preservation status of individual films as well as collections. The project was conceived as a way to develop a tool that gives film archivists greater control over and access to data generated in the course of

film preservation activities. Improved tracking of preservation metadata should aid in the long-term access and sustainability of collections.

An internet application: the Film Preservation Metadata Application (FPM) will be developed to store and display three types of structured data:

- Administrative information such as the title, call number, collection number and other immutable characteristics of the film
- Film inspection data showing multiple measures of a film's physical condition
- Preservation event data showing film usage

The primary benefit of this application will be to give film archivists a better overview of their collections, by enabling preservation metadata to be viewed in aggregate as well as in individual records. FPM will enable a number of improvements to archivist workflow. First, archivists will be able to identify and track arbitrary classes of films, such as those at risk. Second, archivists will be able to keep better detailed records of film usage. Third, FPM will assist in organizing films with multiple parts of generations. Fourth, the information provided by FPM will be useful to archivists in setting priorities and allocating conservation resources. Fifth, it will assist archivists in gauging the long-term effectiveness of preservation practices.

Film preservation

How is film preservation different from the preservation of other archival material? Film differs from other archival material in two important ways. First, film is

a time based medium that must be accessed with a mechanical device, a film projector. This presents many opportunities for the film (or the projector) to be damaged. Each time a film is run, it is in contact with the metal sprockets of the film projector for as much as 20 minutes at a time, traversing a total length of as much as 2000 feet. Second, nitrate- and acetate-based films are inherently chemically unstable and are prone to deteriorate rapidly and irreversibly under the right conditions.

Film has three basic components: a plastic base; layers of emulsion applied to the base; and an image in the emulsion. The base will be one of three types of plastic: cellulose nitrate, cellulose acetate, or polyester. Nitrate film stock is relatively rare and its storage is already governed by the National Fire Protection Association standard *NFPA 40 : standard for the storage and handling of cellulose nitrate film*,[i] so it was not considered in the course of this project. Acetate based film stock has been commercially available in a variety of formats since 1909-1911, and is still in use today – thus it will constitute a majority of the content of many moving image archives. Polyester film stock has been widely used since the early 1980s, and has thus far proven to be a fairly stable medium that is resistant to much of the physical and chemical damage that affects acetate film stock. Polyester and acetate film stocks are both subject to image fading and distortion, and film quality and longevity can vary widely by brand and manufacturer.

Acetate film was originally marketed as “safety” film, a replacement for the unstable and highly flammable nitrate film. In a warm, humid or acidic environment, however, acetyl groups may detach from the cellulose plastic base, creating acetic acid.

This will eventually cause the film base to shrink, warp and become brittle, as the free acetic acid breaks the bonds of the cellulose molecular chains. When enough acetic acid is generated, the process become autocatalytic. By the time the odor of vinegar (for triacetate) or mothballs (for diacetate) is noticeable, the process is already advanced enough that acetic acid is leaching out of the plastic into the air. The chemical breakdown of the base will ultimately mean the complete loss of the film. This process is not reversible, but with proper care, it can be slowed considerably.[ii] Standards for storage of acetate film are specified in varying levels of detail in the Image Permanence Institute's (IPI) *IPI Storage Guide for Acetate Film* (Image Permanence Institute, 1993); in the Weissman Preservation Center at Harvard University Libraries' publication *Acetate Film Deterioration: Diagnosis and Storage* (Harvard University Library, 2007); and in the National Film Preservation Foundation's publication *The Film Preservation Guide: The Basics for Archives, Museums and Libraries* (NFPF, 2004).

Preservation metadata

Preservation metadata was defined by the 2001-2002 OCLC and RLG Preservation Metadata Framework Working Group as " intended to support and facilitate the long-term retention of digital information," addressing provenance, authenticity, preservation activity, technical requirements and rights management, all in the context of digital preservation.[iii] Preservation metadata serves two functions: providing information that assists in maintaining the integrity of the digital object; and ensuring future access to the digital object's content. Unlike physical objects, digital objects require managed storage, subject to frequent data integrity checks, backups and hardware lifecycles.

As the OCLC/RLG working group points out, there is less of a need for preservation metadata for non-digital, traditional information resources such as books. Books are relatively static items, with form and content that does not change over time. A book can be preserved for hundreds of years simply by storing it in an appropriate environment, and access to the contents of a book should require no special equipment. Film, on the other hand, shares some attributes with digital objects: it requires special equipment to access; and its physical form and content are subject to change over time, although as a result of natural chemical processes and preservation actions.

The Preservation Metadata: Implementation Strategies (PREMIS) Working Group, was established in 2003 to develop a core set of metadata elements for digital preservation that were independent of any particular implementation and generally applicable to all types of digital material. In 2005, PREMIS published its final report — a data dictionary of core preservation metadata elements, intended to serve as a digital preservation metadata standard. In a digital repository, PREMIS preservation metadata is attached to the digital object it describes, either in a related database, or in a XML wrapper. Since the PREMIS data dictionary was published in 2005, many organizations have begun to implement it in their digital repositories or have created crosswalks with their existing systems.[iv]

Preservation metadata for film

In many moving image archives, there already exists a system to store a type of

film preservation metadata – the film condition report, a paper form that serves as an inspection checklist and as a record of the condition of a film at a particular point in time. The National Film Preservation Foundation's 2004 publication *The Film Preservation Guide: The Basics for Archives, Libraries, and Museums* contains a sample form [v] that covers some of the basic data needed to get a good sense of the general condition of a film, and to answer questions such as "is this film projectable using available film equipment?" The form includes data about immutable characteristics of the film: material; color or black/white; generation; sound; as well as about characteristics that will change over time: fading; pH level; scratches shrinkage; and other types of physical damage or effects of aging.

Other forms surveyed for this project include those from the *Washington State Film Preservation Manual,* the Florida Moving Image Archive, the National Archives, and the Selznick School of Film Preservation. All have similar formats and fields, with the main difference treatment of controlled vocabularies. Some forms simply have blank fields, others have detailed lists of choices. The NARA form has particularly detailed options for the type of film element. The Florida form is designed for video and film, and has a lengthy checklist of condition options. Most of them add a few fields to the basic form from the *Film Preservation Guide*: manufacturer and brand of the film stock; age of the film stock; and odor (vinegar syndrome).

There are a variety of metadata standards for digital video, but for film there are fewer options. The Public Broadcasting Metadata Dictionary (PBCore), for example, is

primarily concerned with technical and descriptive metadata for digital audio and video media objects. First published in 2005, PBCore v1.0 was developed by a team of public radio and television producers, manager, archivists and information scientists. It contains some elements appropriate for film – there are film-specific options in the controlled vocabularies for the elements *formatPhysical* and *formatGenerations*[vi] – but missing are elements for describing the physical condition of film, and changes in that condition over time, in a way that would aid preservation. For digital objects, the detection of a change in image quality or file size would indicate data corruption and trigger replacement of the file with a verified backup copy. For physical objects, there is a natural process of chemical change that can be slowed, but not stopped. Preservation metadata for physical objects must be capable of tracking those physical changes. Existing preservation metadata schemas are concerned only with digital objects, so they cannot fully accommodates this need of motion picture film preservation. This project aims to fill that need, taking an existing film preservation tool, the film inspection form, and rendering it in a digital, database-driven domain.

A computer-based and database-driven tool for creating and storing preservation metadata offers important advantages over a paper form based system. Film archivists will be able to have an "at-a-glance" overview of the condition of a collection or a subset of a collection; see at a glance which films are most in need of conservation; and track changes in condition over time and conservation events. Similar to the way in which a library catalog enables access via subject and content, such a tool would enable access via physical characteristics. The current system of paper inspection forms only enables

access via collection, as forms from a particular collection are filed together; or per item, as forms related to a particular item will share that item's call number.

II. The Film Preservation Metadata Application (FPM)

Project Overview

The goal of this project is to produce a working prototype of a web-based software application that will store, manipulate and present film preservation metadata from UNC's moving image collections. Film preservation metadata elements for this purpose were largely drawn from the existing film inspection form that is currently in use in Wilson Library at UNC. The Film Preservation Metadata application (FPM) will store three types of information:

1. Film Inspection Form. This form is to be used to record administrative, descriptive and preservation metadata for any film.
2. Preservation Event Form. This form is to be used to record details of any film preservation event. It may be independent or it may be connected to a Film Inspection Form.
3. Administrative information related to the above forms: dates of creation; dates edited; created and edited by whom; revisions.

FPM will store these data records in a database, allowing them to be searched, sorted and displayed on a controlled-access website in both summary and full-record form. In order to populate FPM with data, it can be entered in the course of a film inspection, or there can be retrospective conversion from existing paper film inspection forms. For the

purpose of this project, a sample set of data was used from two collections: Tom Davenport and Harry Lee Harllee, each of which had generated a substantial quantity of paper inspection forms.

Project Development

The template for the project was initially derived from the standard film preservation aid, a film inspection form. The film inspection form currently in use at Wilson Library at the University of North Carolina at Chapel Hill was developed by Stephanie Stewart, the Moving Image Archivist from 2007 to present. It draws from the basic NFPF form, adding the film wind; the manufacturer and brand of the film stock; date code and age of the film stock; and measured shrinkage. It seemed practical for this form to serve as the model for the construction of the digital form, so that existing data on dozens of completed film inspection forms could be easily entered into the new system.

The FPM application allows the operator to designate relationships between separate data records to describe a common physical object or collection of objects. Its proposed metadata schema (see Appendix II) provides a system for creating item-level administrative records about films, with information such as: film gauge; edge code (indicating date of manufacture); processing date; generational data (original, negative or reversal, positive print, reversal print, etc.); condition data (shrinkage, physical damage, pH reading, image fading, etc.); and preservation events (inspection/cleaning on xx date; pH reading taken on xx date; etc.). Preservation events are measurements or actions such as disaster event and recovery, conservation work, making a print, rehousing,

reformatting, projecting – anything that yields new data or has the potential to physically impact the condition of the film.

Platform

The computing platform used for this project is Linux, Apache, MySQL and PHP (LAMP). LAMP is a set of free and open source software that together represent a fully-functional web server.[vii] The project was assembled in Drupal, an open source, PHP-based content management framework. Drupal was selected for two primary reasons: it is open source and easily customizable with knowledge of PHP; and it has an active development community that has created many plugins or modules that are particularly helpful in building a system like FPM. Drupal's core features provide the basic functionality needed for this project: user accounts with customizable access privileges; administration menus; customizable layout; logging and revision tracking; and, with the modules described below, the ability to create custom, complex content types with user-defined fields and controlled vocabularies.

Design Considerations

In designing the site's data structure, the first decision to be made was how to define the types of records to be stored. Two distinct types of actions are to be logged: inspections and preservation events. In the current system of paper Film Inspection Forms every form is identical, representing a record of a single inspection of a single film. When a film is inspected the second or third time, the form that is filled out is identical to the form filled out the first time, resulting in some redundant data. For

example, the film's title and manufacturer will not change; but its color may fade over time. There is not currently a formal system in place for tracking preservation events, so that form is a simple one, with only the basic identifying information for a film, and a large field to describe the preservation event.

The FPM application had to be able to store and link together multiple forms, representing both multiple inspections of the same item; as well as preservation events which could affect one or more films in a collection. One approach was to split the metadata into three separate records:

- administrative and descriptive metadata that does not change over time, such as the title; type of film stock; whether the film is in color and has sound; etc.
- inspection-derived metadata related to the film's condition, which may change over time
- metadata related to preservation events

This had the advantage of not repeating any data unnecessarily, but it would also be useful for the administrative and descriptive metadata from section 1 to be somehow attached to the inspection-derived metadata and preservation event metadata. If a record of type 2 or 3 was viewed individually, outside of the context of the first record, much identifying information would be missing. The solution was to define three record types, each with shared identifying administrative information, and linked in a parent-child relationship.

Project Design and Workflow

The first time a film is inspected, users create an Initial Film Inspection form, which contains a full set of metadata: administrative metadata (title, collection, shelf location); descriptive metadata (film type, manufacturer, edge code, etc.); and condition metadata (number of splices; evaluation of edge damage, color fading, etc.). Upon the creation of child nodes from the initial, parent node, the administrative information is copied from parent to child. This approach allows the records to be explicitly linked together, and to be viewed separately without a loss of context.

The next step was to define and group the fields for each content type. The initial inspection form includes all of the fields from the paper inspection form, but with some additions and a slightly different organization. The fields are grouped according to function. Basic identifying information is at the top: title, work title, collection number, call number, shelf location and date of inspection. Next are descriptive fields: film gauge, type, base, edge code, date, wind, element, color and sound. Inspection fields are next: projectable, length, length measured or estimated; number of splices; head and tail spliced; and shrinkage. Following are damage measurement fields: scratches, warping, oil and dirt, color fading, perforation/edge damage and repair. At the end is a larger field for notes.

The subsequent inspection form includes the same fields as the initial inspection form, excluding the description section, as it contains characteristics of the film that do not change, such as the film gauge and manufacturer. The preservation event form

includes only the basic identifying information and an open field to describe the nature of the preservation event.

The process of recreating each field highlighted one small advantage that the paper form has over the digital form. The FPM edge code field must be filled in with a description of the edge code rather than a simple drawing of the edge code itself, as keyboards lack the keys necessary to draw circle-square-triangle. Fields that are intended to hold a single value can be filled with multiple values and notes and diagrams can be scribbled in the margins.

With the content types defined and data fields created, the next step was to define the possible relationships between different types of content. In Drupal, each content type is called a node, and each node represents a distinct data record. The initial inspection form is defined as a parent node, to which can be added child nodes, in the form of subsequent inspection forms or preservation events. A subsequent inspection form may only be created as a child node, but a preservation event can be created independently and later attached to an initial inspection form. This is done to accommodate situations in which the user may wish to begin recording preservation event data before there has been time to complete a full initial inspection.

After creating and defining the content types and relationships, the project is nearly complete. Data from film inspection forms from the Harllee and Davenport

collections has been entered into the system; this will provide a means of testing the data entry system; and of demonstrating how the data will be displayed.

Project Evaluation

The system is successful so far at attaining its stated goals — it is a functional repository for film preservation metadata. It has been built, however, to suit an individual workflow, and has not had any user testing or outside evaluation. After further testing and refinement, it should be a robust and flexible enough system that it could be released to the public and implemented at other institutions. Once the design has been finalized, the system will be packaged as a freely available module that will allow anyone to easily set up the FPM application on any web server that can host Drupal. It can also serve as a proof of concept for other, similar tools that could be developed to track preservation metadata for other types of physical media, such as paper documents or magnetic tape.

The process of retrospective conversion of existing data has already begun with the set of sample records from the Tom Davenport and Harry Lee Harllee collections. The addition of the remaining records from those collections and those from other collections will provide some useful information on how well the system works with data generated by several different people with varying levels of detail.

The next step in testing will be to add additional user accounts for existing staff and begin using the system in Wilson Library for the collection of new data from future

film inspections and preservation events. Will it be practical to enter data at a computer terminal while in the midst of doing a film inspection, or will it prove to be easier to record the data by hand and then type it in all at once? Would it be practical to adapt FPM for use with a mobile device? What types of data reporting will be most useful for a working archive? These are questions that only use-testing will be able to answer.

Conclusion

The Film Preservation Metadata application was developed in an attempt to provide a tool for film archivists to replace or to augment an existing system of film inspection forms, and to enhance archivists' ability to maintain large collections of film material. Its reporting functions give archivists a broad, aggregate view of data that could previously only be viewed as isolated data points on single paper forms.

As of this writing (Summer 2009), the application exists as a web-based application that is accessible at the URL <http://ibiblio.org/ethan/film/>. Guest access is available with the username *guest* and the password *wilson*. Guests may view the sample data but may not edit it or add new data.

Notes

[i] National Fire Protection Association. (2007). NFPA 40: *Standard for the storage and handling of cellulose nitrate film*. Quincy, Mass: National Fire Protection Association.

[ii] Reilly, J. M., Adelstein, P. Z., & Nishimura, D. W. (1991). *Preservation of safety film: Final report to the Office of Preservation, National Endowment for the Humanities*. Rochester, N.Y.: Image Permanence Institute, Rochester Institute of Technology.

[iii] OCLC/RLG Working Group on Preservation Metadata, OCLC., & Research Libraries Group. (2001). *Preservation metadata for digital objects A review of the state of the art : a white paper.* Dublin, Ohio: OCLC/RLG Working Group on Preservation Metadata. http://www.oclc.org/digitalpreservation/presmetawp.pdf.

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Appendix I

Using the FPM application

Once a user has an account with permission to create new metadata records in the FPM application, operation is straightforward. On the main page, the right column has a section labeled *Create new content,* under which there are two links: *Initial inspection form* and *Preservation event.* Clicking either of those will bring up the appropriate form. The top part of both forms contains administrative metadata such as the title of the item, the collection and other identifying information. The next section of the initial inspection form contains descriptive metadata such as the film type and gauge, and the final section contains preservation metadata that describes the physical condition of the film at the time of inspection. The preservation event form contains only the top administrative section and a field for describing the nature of the preservation event.

Most of the administrative and descriptive fields make use of the autocomplete widget, which will automatically present options that attempt to match the text being entered to existing field data. This represents an effort to implement a semi-controlled vocabulary that offers greater flexibility than a fully-controlled vocabulary; users can see what has been entered in that particular field in other records, but is not constrained to those choices.

To add a subsequent inspection as a child node to an existing initial inspection, the user must view the item's initial inspection record. Below the *Create New Content* menu in the right column is a new menu heading, *Add An Inspection Or Preservation Event To*

This Item. This menu offers the options to create a new inspection form or preservation event that will be a child node of the item being viewed; or to attach an existing preservation event to this item.

After each form is filled out and submitted, an entry for it will appear in the top position in the center column on the site's homepage. This column simply displays the most recent content in the system, in the order in which it was created. Content is also accessible via a search field in the right column, and browsable via a list of collections, a link to which is found in the left column. The collections page displays a list of the name of each collection from which at least one item has been inspected, and a number indicating how many records from that collection are present in the system. Parent nodes are always presented with accompanying links to any child nodes.

Appendix II

Metadata mapping

Table I illustrates how the metadata elements from the FPM Initial Inspection Form are mapped to the corresponding PBCore elements and element containers. PBCore element containers are formatted as so: elementContainer: element1; element2: descriptor. There are only a few direct mappings – most FPM elements fall under PBCore's catch-all element, pbcoreAnnotation: annotation. Because PBCore does not mandate the use of controlled vocabularies, it is possible to force mapping between elements that are not clearly related, but the focus here is on direct mapping, in order to accommodate the option of interoperability with other systems that use the PBCore schema. There are too few mappings to allow the sharing of inspection data, but there are enough descriptive metadata mappings to allow films to be matched by physical attributes.

FPM v1.0 element	PBCore v1.1 element	Descripton
Title	pbcoreTitle: title; titleType: Alternative	Unique item title
Work title	pbcoreTitle: title	Work title, used to link to other items that share the same intellectual content
Collection name	pbcoreTitle: title; titleType: Collection	Collection name
Collection number	pbcoreTitle: title; titleType: Collection	Collection number
Shelf location	pbcoreInstantiation: formatLocation	Shelf location
Call number	pbcoreInstantiation: formatIdentifier	Unique call number
General condition	pbcoreAnnotation: annotation	Brief condition summary
Date inspected	pbcoreAnnotation: annotation	Date inspected
Projectable	pbcoreAnnotation: annotation	Projectable on normal equipment?
Film gauge	pbcoreInstantiation: formatPhysical	Film gauge or width
Film type	pbcoreAnnotation: annotation	Film brand and manufacturer
Film base	pbcoreAnnotation: annotation	Film base material
Edge code description	pbcoreAnnotation: annotation	Manufacturer edge code
Edge code date	pbcoreInstantiation: dateCreated	Date derived from edge code
Wind	pbcoreAnnotation: annotation	A- or B-wind
Element	pbcoreInstantiation: formatGenerations	Type of film element
Color	pbcoreInstantiation: formatColors	Color

Sound	pbcoreInstantiation: formatSound	Type of sound
Length	pbcoreAnnotation: annotation	Film length, measured in feet
Length measured	pbcoreAnnotation: annotation	Length measured or estimated
Number of splices	pbcoreAnnotation: annotation	Number of splices
Head, tail spliced	pbcoreAnnotation: annotation	Head or tail spliced with leader
Measured shrinkage	pbcoreAnnotation: annotation	Measured shrinkage
Emulsion scratches	pbcoreAnnotation: annotation	Scratches on emulsion side
Base scratches	pbcoreAnnotation: annotation	Scratches on base side
Warping	pbcoreAnnotation: annotation	Warping
Oil, dirt	pbcoreAnnotation: annotation	Oil, dirt
Color fading	pbcoreAnnotation: annotation	Color fading
Perforation damage	pbcoreAnnotation: annotation	Perforation damage
Edge damage	pbcoreAnnotation: annotation	Edge damage
Perforation, edge repair	pbcoreAnnotation: annotation	Evidence of previous repair to perforations and edges
A-D strip level	pbcoreAnnotation: annotation	Measurement of acidity
Notes	pbcoreAnnotation: annotation	Notes

Appendix III

Third-party Drupal modules

Modules are third-party software extensions that add new functionality to Drupal. Like Drupal itself, they are open source and freely available.

1. *Autocomplete widgets for CCK text and number 6.x-1.0* – provides autocomplete functionality for administrative and descriptive metadata fields. Autocomplete content is drawn from existing entries. This function supports the copying of basic administrative metadata from a parent record to a new child record.
2. *Content Construction Kit (CCK) 6.x-2.5* – allows the creation of custom content types: the initial inspection form; subsequent inspection form; and preservation event.
3. *Content Taxonomy 6.x1.0-rc1* – auto-generates taxonomy terms from data entered in administrative and descriptive metadata fields. This allows the easy creation of index pages such as collection, title, shelf location, film gauge, film type, etc.
4. *Node Relativity 6.x-1.2* – allows the definition of parent-child relationships between the initial inspection, subsequent inspection and preservation events
5. *Prepopulate 6.x-1.1* – prepopulates fields in a new child node with content from the parent node's fields. In order to implement this, a custom module was created that integrates with the Node Relativity module, above. Its purpose is to modify the links presented in parent nodes that, when clicked, trigger the creation of a new child node.